2001 TERRESTRIAL RESOURCE MONITORING IN LOWER GRAND CANYON - WILDLIFE, VEGETATION AND ETHNOBOTANY

Submitted to:

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August, 2001

INTRODUCTION

The Colorado River in Lower Grand Canyon supports some of the most abundant and diverse riparian vegetation and wildlife communities in the southwestern United States (Christensen 1997). The operation of Glen Canyon Dam and the elevations of Lake Mead have the potential to greatly affect these terrestrial resources through inundation, scouring and dessication (Christensen et al. 1997). The objective of these studies were to 1) re-establish a long-term data base regarding the status and trends of vegetation and wildlife communities in lower Grand Canyon, 2) attempt to examine the effects of recent flow experiments such as the Slow, Steady Summer flows of FY2000 on terrestrial resources of lower Grand Canyon, 3) to monitor the effects of Glen Canyon Dam operations on ethnobotanical resources in lower Grand Canyon and 4) to attempt to understand from a traditional Hualapai viewpoint the health and dynamics of terrestrial resources in lower grand Canyon.

Background

The Hualapai Tribe previously monitored wildlife and vegetation communities of lower Grand Canyon from 1992 to 1997 (Christensen 1996, 1997). From 1997 through 2000, the Tribe was not selected to continue these studies as part of the Glen Canyon Dam Adaptive Management Program (GCDAMP) administered by the Grand Canyon Monitoring and Research Center (GCMRC). Additionally, since 1997, the operation of Glen Canyon Dam has undergone several experimental flow regimes such as the Slow, Steady Summer Flow (SSSF) experiment of 2000, the habitat maintenance flow of 1999 and the recent low flows punctuated by emergency flow releases. Because of the unusual flow regimes and the need to establish and maintain a long-term data base regarding the status and trends of wildlife and vegetation communities in lower Grand Canyon, GCMRC funded a modest wildlife and vegetation monitoring program for the Hualapai Tribe in FY2001.

The FY2001 terrestrial monitoring effort consisted of four, three-day bird, small mammal and reptile surveys between Diamond Creek and Pearce Ferry, one, three-day vegetation and ethnobotanical survey in the lower canyon and one 18 day trip where a representative assisted other contractors in performing wildlife, insect and vegetation monitoring between Lee's Ferry and Diamond Creek. The timing, locations and methods used for these surveys are given below.

METHODS

Avian Surveys

Avian surveys were performed on June 4-6, June 18-20, July 2-4 and July 16-18 at Spencer Beach, Surprise Creek, Burnt Springs, Quartermaster Canyon, River Mile 264.0L and across from the

Bat Cave in lower Grand Canyon. Here, we established point-count stations with a 30 meter radius at each of the sites with Spencer Beach having two points and Quartermaster Canyon with three. Each of the other sites had a single point. We counted the number of each species at each station for fifteen minutes each morning by hearing their song or by seeing the bird. Birds such as the Common Raven and Great-blue Heron were included if they flew over the plot during the survey or if they landed in the plot.

Small Mammal Surveys

Two, trap-line transects were established both at Spencer Beach and at Quartermaster Canyon where 30 to 50 traps were set along each transect. One of the transects was in the riparian vegetation and one in the upland habitat at both sites. Each trap line was set and monitored for one night each trip (as listed above). The traps were set after sunset, baited with rolled oats and checked prior to sunrise the next morning. Captured animals were identified to species and released.

Reptile Surveys

We performed reptile surveys at Spencer Beach and Quartermaster Canyon on the same dates as avian surveys were done. Here, two transects of approximately 50 meters in length were walked for a period of 30 minutes and all reptiles within a width of 20 meters were recorded. One transect was located in an upland and one in the riparian vegetation at both sites.

Ethnobotanical Monitoring

Three vegetation monitoring transects were established at National Canyon, Granite Park, Diamond Creek, Bridge Canyon and Spencer Canyon by Dr. Arthur Phillips III in 1997. To establish a transect, a tape was laid perpendicular from the river through the riparian vegetation until the upland rock was encountered. The portion of that tape intersected by each species of plant was re-measured in 2001 and compiled for each transect. Mean coverage across species were then compared to previous coverages using a MANOVA test (Multivariate Analysis of Variance). Photographs from the beginning and end of each transect, as well as other photographs as necessary, were taken so that the transect could be relocated for future comparisons.

RESULTS AND DISCUSSION

Avifauna Monitoring

We monitored a total of ten point-count stations from June 5 to July 18, 2001 at bi-weekly intervals. Spencer Beach station #1 up Spencer Creek away from the mainstem Colorado River, Quartermaster station #1 at the back of Quartermaster Canyon, river mile 264.0L and across from the Bat Cave had the highest bird densities of the sites monitored (Table 1). Spencer Beach station #3 in the front tamarisk vegetation and Surprise Creek had the lowest abundances. Both of these are the only stands without a significant willow presence suggesting that willow habitats are superior to tamarisk with regard to bird abundances. Any dam operation that favors willow establishment over tamarisk would likely improve riparian habitats in lower Grand Canyon for birds.

The abundant willow/cottonwood forest up from the mouth of Spencer Beach appears to be prime habitat for a variety of birds including the endangered Southwestern Willow Flycatcher that has been located there for the past several years. Other sites such as Quartermaster Canyon, Burnt Springs, river mile 264.0 and across from the Bat Cave also have an abundance of riparian vegetation dominated by Goodding's willow and supported an appreciable numbers of birds (Table 1).

The overall total bird densities for Spencer Canyon, Quartermaster Canyon and river mile 264.0L were within the range of variation established from previous studies (Table 1a; Christensen 1997). In 1997, we documented the highest bird densities since we began monitoring in 1991, while the numbers in 1996 were the lowest documented to date. Thus, the numbers for 2001 are slightly above the average of 1996 and 1997 suggesting that the habitats in lower Grand Canyon continue to support substantial numbers of birds. **Funding limitations precluded statistical comparisons of between-year avian abundances.** A breakdown of bird abundances at each point-count station are given in Table 1b.

Table 1. Summary of avian abundances and diversities across sites in 2001.

SITE	MEAN # OF SPECIES	MEAN # OF INDIVIDUALS	MEAN #/ HECTARE / SPECIES	TOTAL #/ HECTARE (Xbar)	# OF SURVEYS
Spencer Beach - #1 up creek	12.3	44.5	4.7	57.2	4
Spencer Beach - #2 up creek	11.0	34.0	3.7	39.7	4
Spencer Beach - #3 front riparian	9.3	26.7	3.6	33.8	3
Burnt Springs	9.5	36.0	5.0	47.3	2
Surprise Creek	5.7	8.7	2.0	10.8	3
Quartermaster - #1 back	13.5	43.5	4.4	55.3	4
Quartermaster - #2 middle	12.0	37.3	4.2	48.9	4
Quartermaster - #3 front	11.3	33.0	4.1	43.5	4
RM 264.0L	12.0	39.7	3.9	51.6	3
Bat Cave	11.3	42.7	5.1	57.3	3

Table 1a. Summary of total numbers of birds at each site for 1996, 1997 and 2001 for all points averaged at each site.

SITE	1996 MEAN #/ 40 HECTARES	1997 MEAN #/ 40 HECTARES	2001 MEAN #/ 40 HECTARES
Spencer Canyon	1,048.8	2,368.0	1,742.7
Quartermaster Canyon	726.8	1,336.0	1,969.3
RM 264.0L	1,604.4	2,124.0	2,064.0
Totals	3,380.0	5,828.0	5,776.0

Table 1b. The mean number of birds per species and mean total number of birds at each point count station in 2001.

SITE/POINT	MEAN#/ HECTARE/ SPECIES	TOTAL #/ HECTARE	NUMBER OF SURVEYS
Spencer #1	4.7	57.2	4
Spencer #2	3.7	39.7	4
Spencer #3	3.6	33.8	3
Quartermaster #1	4.4	55.3	4
Quartermaster #2	4.2	48.9	4
Quartermaster #3	4.1	43.5	4
Surprise Creek	2.0	10.8	3
Burnt Springs	5.0	47.3	2
RM 264.0L	3.9	51.6	3
Bat Cave	5.1	57.3	3

Yellow-breasted Chat, Bell's Vireo, Song Sparrow, Common Yellowthroat, Lucy's Warbler, Yellow Warbler, Blue-gray Gnatcatcher and Bewick's Wren were the most common and abundant species found across all sites and stations (Tables 2-35). No Southwestern Willow

Flycatchers were located by our staff, but the staff of the San Bernardino County Museum did locate an abandoned nest and saw individuals up the creek at Spencer Canyon in late July.

Spencer Beach

Table 2. Spencer Beach Avian Monitoring - June 5, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/05/01- #1 (up creek)	Yellow-breasted Chat	5	6.4
	Bell's Vireo	7	8.9
	Blue-gray Gnatcatcher	5	7.6
	Song Sparrow	6	7.6
	Lucy's Warbler	6	7.6
	Bewick's Wren	5	6.4
	Common Yellowthroat	5	6.4
	Ash-throated Flycatcher	2	2.6
	Mourning Dove	2	2.6
	Brown-headed Cowbird	2	2.6
	Black-chinned Hummingbird	2	2.6
	Canyon Wren	1	1.3
	Yellow Warbler	1	1.3
Total #/ Hectare	Ladder-backed Woodpecker	1	1.3
S = 65.8	**Total**	**50**	**Mean = 4.7**

Table 3. Spencer Beach Avian Monitoring - June 5, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/05/01 #2 (up creek)	Song Sparrow	3	3.8
	Blue-gray Gnatcatcher	4	5.1
	Yellow-breasted Chat	5	6.4
	Common Yellowthroat	6	7.6
	Lucy's Warbler	3	3.8
	Bell's Vireo	5	6.4
	Yellow Warbler	4	5.1
	Canyon Wren	2	2.6
	Mourning Dove	1	1.3
	Common Raven	1	1.3
Total #/ Hectare	Bewick's Wren	2	2.6
S = 46.2	**Totals**	**36**	**Mean = 4.2**

Table 4. Spencer Beach Avian Monitoring - June 6, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/05/01- #3 (riparian)	Common Yellowthroat	6	7.6
	Yellow-breasted Chat	5	6.4
	Bell's Vireo	5	6.4
	Blue-gray Gnatcatcher	4	5.1
	Yellow Warbler	4	5.1
	Song Sparrow	3	3.8
	Lucy's Warbler	3	3.8
	Canyon Wren	2	2.6
Total #/ Hectare	Bewick's Wren	2	2.6
S = 43.2	**Totals**	**36**	**Mean = 4.8**

Table 5. Spencer Beach Avian Monitoring - June 19, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/19/01- #1 (up creek)	Yellow-breasted Chat	6	7.6
	Bell's Vireo	3	3.8
	Blue-gray Gnatcatcher	4	5.1
	Song Sparrow	5	6.4
	Lucy's Warbler	5	6.4
	Bewick's Wren	3	3.8
	Common Yellowthroat	5	6.4
	Ash-throated Flycatcher	2	2.6
	Mourning Dove	2	2.6
	Brown-headed Cowbird	2	2.6
	Black-chinned Hummingbird	1	1.3
	Canyon Wren	2	2.6
	Yellow Warbler	3	3.8
	Brown-headed Cowbird	1	1.3
Total #/ Hectare	Blue Grosbeak	1	1.3
S = 57.0	**Total**	**45**	**Mean = 3.8**

Table 6. Spencer Beach Avian Monitoring - June 19, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/19/01- #2 (up creek)	Common Yellowthroat	5	6.4
	Lucy's Warbler	4	5.1
	Yellow-breasted Chat	4	5.1
	Song Sparrow	4	5.1
	Bewick's Wren	2	2.6
	Canyon Wren	2	2.6
	Black-chinned Hummingbird	1	1.3
	Hooded Oriole	1	1.3
	Ash-throated Flycatcher	2	2.6
	Bell's Vireo	4	5.1
	Blue-gray Gnatcatcher	3	3.8
Total #/ Hectare	Common Raven	1	1.3
S = 42.0	**Totals**	**33**	**Mean = 3.5**

Table 7. Spencer Beach Avian Monitoring - June 19, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# per HECTARE**
06/19/01- #3 (riparian)	Common Raven	2	2.6
	Yellow-breasted Chat	2	2.6
	Bell's Vireo	4	5.1
	Blue-gray Gnatcatcher	2	3.8
	Lucy's Warbler	4	5.1
	Song Sparrow	5	6.4
	Lucy's Warbler	3	3.8
	Canyon Wren	2	2.6
	Brown-headed Cowbird	1	1.3
	Great-blue Heron	1	1.3
Total #/ Hectare	Bewick's Wren	1	1.3
S = 36.3	**Totals**	**27**	**Mean = 3.3**

Table 8. Spencer Beach Avian Monitoring - July 3, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/03/01- #1 (up creek)	Yellow-breasted Chat	9	11.4
	Bell's Vireo	3	3.8
	Blue-gray Gnatcatcher	4	5.1
	Song Sparrow	8	10.2
	Lucy's Warbler	6	7.6
	Bewick's Wren	4	5.1
	Common Yellowthroat	7	8.9
	Yellow Warbler	5	6.4
	Black-chinned Hummingbird	2	2.6
	Canyon Wren	5	6.4
	Common Raven	1	1.3
Total #/ Hectare	House Finch	1	1.3
S = 70.1	**Totals**	**55**	**Mean = 5.8**

Table 9. Spencer Beach Avian Monitoring - July 3, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/03/01 - #2 (up creek)	Yellow-breasted Chat	6	7.6
	Lucy's Warbler	4	5.1
	Common Yellowthroat	5	6.4
	Blue-gray Gnatcatcher	2	2.6
	Song Sparrow	4	5.1
	Black-chinned Hummingbird	2	2.6
	Canyon Wren	1	1.3
	Bewick's Wren	1	1.3
	Yellow Warbler	2	2.6
	Common Raven	2	2.6
	Red-tailed Hawk	1	1.3
	Ash-throated Flycatcher	1	1.3
Total #/ Hectare	Cassin's Finch	1	1.3
S = 41.1	**Totals**	**32**	**Mean = 3.2**

Table 10. Spencer Beach Avian Monitoring - July 3, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/03/01- #3 (riparian)	Common Yellowthroat	0	0
	Yellow-breasted Chat	3	3.8
	Bell's Vireo	3	3.8
	Blue-gray Gnatcatcher	3	3.8
	Yellow Warbler	0	0
	Song Sparrow	2	2.6
	Lucy's Warbler	2	2.6
	Canyon Wren	2	2.6
	Common Raven	1	1.3
Total #/ Hectare	Mourning Dove	1	1.3
S = 21.8	**Totals**	**17**	**Mean = 2.7**

Table 11. Spencer Beach Avian Monitoring - July 17, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/17/01- #1 (up creek)	Yellow-breasted Chat	7	8.9
	Song Sparrow	4	5.1
	Bell's Vireo	4	5.1
	Common Yellowthroat	5	6.4
	Lucy's Warbler	4	5.1
	Blue-gray Gnatcatcher	1	1.3
	Canyon Wren	2	2.6
Total #/ Hectare	Ash-throated Flycatcher	1	1.3
S = 35.8	**Totals**	**28**	**Mean = 4.5**

Table 12. Spencer Beach Avian Monitoring - July 17, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/17/01- #2 (up creek)	Common Yellowthroat	5	6.4
	Yellow-breasted Chat	5	6.4
	Blue-gray Gnatcatcher	2	2.6
	Song Sparrow	4	5.1
	Ash-throated Flycatcher	2	2.6
	Bell's Vireo	2	2.6
	Lucy's Warbler	2	2.6
Total #/ Hectare	Canyon Wren	1	1.3
S = 29.6	**Totals**	**23**	**Mean = 3.7**

Quartermaster Canyon

Table 13. Quartermaster Canyon Avian Monitoring - June 5, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/06/01 - #1 (falls)	Bell's Vireo	13	16.6
	Yellow Warbler	8	10.2
	Lucy's Warbler	8	10.2
	Song Sparrow	7	8.9
	Yellow-breasted Chat	6	7.6
	Bewick's Wren	4	5.1
	Blue-gray Gnatcatcher	4	5.1
	Ash-throated Flycatcher	3	3.8
	House Finch	3	3.8
	Canyon Wren	2	2.6
	Say's Phoebe	2	2.6
	Common Raven	1	1.3
Total #/ Hectare	Blue Grosbeak	1	1.3
S = 79.1	**Totals**	**63**	**Mean = 6.1**

Table 14. Quartermaster Canyon Avian Monitoring - June 6, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/06/01 - #2 (middle)	Bell's Vireo	10	12.7
	Yellow Warbler	9	11.4
	Song Sparrow	5	6.4
	Yellow-breasted Chat	5	6.4
	Lucy's Warbler	5	6.4
	Blue-gray Gnatcatcher	4	5.1
	Bewick's Wren	3	3.8
	House Finch	2	2.6
	Ash-throated Flycatcher	2	2.6
	Black-chinned Hummingbird	2	2.6
Total #/ Hectare	Say's Phoebe	2	2.6
S = 62.6	**Totals**	**49**	**Mean = 5.7**

Table 15. Quartermaster Canyon Avian Monitoring - June 6, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/06/01- #3 (front)	Yellow Warbler	7	8.9
	Lucy's Warbler	6	7.6
	Song Sparrow	6	7.6
	Bell's Vireo	6	7.6
	Yellow-breasted Chat	5	6.4
	Blue-gray Gnatcatcher	3	3.8
	Canyon Wren	2	2.6
	Black Phoebe	2	2.6
Total #/ Hectare	Black-chinned Hummingbird	1	1.3
S = 48.4	**Totals**	**38**	**Mean = 5.4**

Table 16. Quartermaster Canyon Avian Monitoring - June 20, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/20/01 - #1 (falls)	Bell's Vireo	5	6.4
	Common Yellowthroat	4	5.1
	Lucy's Warbler	5	6.4
	Song Sparrow	3	3.8
	Yellow-breasted Chat	4	5.1
	Bewick's Wren	2	2.6
	Blue-gray Gnatcatcher	3	3.8
	Ash-throated Flycatcher	3	3.8
	House Finch	3	3.8
	Canyon Wren	2	2.6
	Brown-headed Cowbird	2	2.6
	Common Raven	1	1.3
	Black-chinned Hummingbird	2	2.6
	Common Raven	2	2.6
Total #/ Hectare	Mourning Dove	2	2.6
S = 55.1	**Totals**	**43**	**Mean = 3.7**

Table 17. Quartermaster Canyon Avian Monitoring - June 20, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/20/01 - #2 (middle)	Bell's Vireo	4	5.1
	Common Yellowthroat	4	5.1
	Song Sparrow	4	5.1
	Yellow-breasted Chat	4	5.1
	Lucy's Warbler	3	3.8
	Blue-gray Gnatcatcher	2	2.6
	Bewick's Wren	2	2.6
	Black Phoebe	2	2.6
	Ash-throated Flycatcher	2	2.6
	Black-chinned Hummingbird	1	1.3
	Ladder-backed Woodpecker	1	1.3
	Common Raven	2	2.6
	Canyon Wren	1	1.3
Total #/ Hectare	Say's Phoebe	3	3.8
S = 44.9	**Totals**	**35**	**Mean = 3.2**

Table 18. Quartermaster Canyon Avian Monitoring -June 20, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/20/01- #3 (front)	Yellow Warbler	7	8.9
	Lucy's Warbler	10	12.7
	Song Sparrow	1	1.3
	Bell's Vireo	8	10.2
	Yellow-breasted Chat	2	2.6
	Blue-gray Gnatcatcher	3	3.8
	Canyon Wren	2	2.6
	Black Phoebe	2	2.6
	Common Yellowthroat	2	2.6
	House Finch	2	2.6
	Bewick's Wren	2	2.6
Total #/ Hectare	Black-chinned Hummingbird	1	1.3
S = 53.8	**Totals**	**42**	**Mean = 4.5**

Table 19. Quartermaster Canyon Avian Monitoring - July 4, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/04/01- #1 (falls)	Bell's Vireo	3	3.8
	Yellow Warbler	0	0
	Lucy's Warbler	4	5.1
	Song Sparrow	5	6.4
	Yellow-breasted Chat	6	7.6
	Bewick's Wren	3	3.8
	Blue-gray Gnatcatcher	3	3.8
	Ash-throated Flycatcher	2	2.6
	House Finch	2	2.6
	Canyon Wren	2	2.6
	Say's Phoebe	0	0
	Common Raven	0	0
	Blue Grosbeak	0	0
	Common Yellowthroat	5	6.4
	Great-blue Heron	1	1.3
Total #/ Hectare	Black-chinned Hummingbird	1	1.3
S = 47.3	**Totals**	**37**	**Mean = 3.9**

Table 20. Quartermaster Canyon Avian Monitoring - July 4, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/04/01/ #2 (middle)	Bell's Viréo	5	6.4
	Yellow Warbler	0	0
	Common Yellowthroat	5	6.4
	Song Sparrow	4	5.1
	Yellow-breasted Chat	6	7.6
	Lucy's Warbler	5	6.4
	Blue-gray Gnatcatcher	4	5.1
	Bewick's Wren	2	2.6
	House Finch	2	2.6
	Ash-throated Flycatcher	3	3.8
	Hooded Oriole	2	2.6
	Common Raven	1	1.3
Total #/ Hectare	Black-chinned Hummingbird	3	3.8
S = 58.7	**Totals**	**42**	**Mean = 4.9**

Table 21. Quartermaster Canyon Avian Monitoring - July 4, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/04/01/ #3 (riparian/front)	Song Sparrow	3	3.8
	Bell's Vireo	4	5.1
	Blue-gray Gnatcatcher	4	5.1
	Lucy's Warbler	5	6.4
	Yellow-breasted Chat	4	5.1
	Hooded Oriole	1	1.3
	Bewick's Wren	1	1.3
	Great-blue Heron	1	1.3
	Canyon Wren	3	3.8
	Yellow Warbler	1	1.3
	Black Phoebe	3	3.8
Total #/ Hectare	Say's Phoebe	1	1.3
S = 39.6	**Totals**	**26**	**Mean = 3.3**

Table 22. Quartermaster Avian Monitoring - July 18, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/18/01- #1 (falls)	Song Sparrow	5	6.4
	Common Yellowthroat	5	6.4
	Yellow-breasted Chat	5	6.4
	Canyon Wren	2	2.6
	Bell's Vireo	3	3.8
	Lucy's Warbler	2	2.6
	Brown-headed Cowbirds	4	5.1
	Blue-gray Gnatcatcher	2	2.6
	Common Raven	1	1.3
Total #/ Hectare	House Finch	2	2.6
S = 39.8	**Totals**	**31**	**Mean = 4.0**

Table 23. Quartermaster Avian Monitoring - July 18, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/18/01/ #2 (middle)	Bell's Vireo	4	5.1
	Common Yellowthroat	4	5.1
	Yellow-breasted Chat	2	2.6
	Ash-throated Flycatcher	3	3.8
	Lucy's Warbler	3	3.8
	Blue-gray Gnatcatcher	2	2.6
	Canyon Wren	1	1.3
	Bewick's Wren	1	1.3
	Say's Phoebe	2	2.6
Total #/ Hectare	Song Sparrow	1	1.3
S = 29.5	**Totals**	**23**	**Mean = 3.0**

Table 24. Quartermaster Avian Monitoring - July 18, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/18/01- #3 (front)	Bell's Vireo	5	6.4
	Yellow-breasted Chat	3	3.8
	Lucy's Warbler	3	3.8
	Song Sparrow	2	2.6
	Canyon Wren	3	3.8
	Hooded Oriole	2	2.6
	Great-blue Heron	1	1.3
	Common Raven	2	2.6
	Blue-gray Gnatcatcher	3	3.8
Total #/ Hectare	Yellow Warbler	1	1.3
S = 32.0	**Totals**	**25**	**Mean = 3.2**

Surprise Creek

Table 25. Surprise Creek Avian Monitoring - June 19, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/19/01/ #1	Song Sparrow	2	2.6
	Yellow-breasted Chat	1	1.3
	Black Phoebe	3	3.8
Total #/ Hectare	Canyon Wren	2	2.6
S = 10.3	**Totals**	**8**	**Mean = 2.6**

Table 26. Surprise Canyon Avian Monitoring - July 3, 2001			
DATE/TRANSECT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/03/01/ #1	Bell's Vireo	1	1.3
	Black Phoebe	1	1.3
	Canyon Wren	2	2.6
	Say's Phoebe	1	1.3
	Mourning Dove	2	2.6
	Great-blue Heron	1	1.3
Total #/ Hectare	Common Raven	1	1.3
S = 11.7	**Totals**	**9**	**Mean = 1.7**

Table 27. Surprise Creek Avian Monitoring - July 18, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/18/01/ #1	Bell's Vireo	2	2.6
	Blue-gray Gnatcatcher	1	1.3
	Lucy's Warbler	2	2.6
	Yellow-breasted Chat	1	1.3
	Great-blue Heron	1	1.3
Total #/ Hectare	Canyon Wren	2	1.3
S = 10.4	**Totals**	**9**	**Mean = 1.7**

Burnt Springs

Table 28. Burnt Springs Avian Monitoring - June 19, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# per HECTARE**
6/19/01/ #1	Lucy's Warbler	5	6.4
	Yellow-breasted Chat	5	6.4
	Bell's Vireo	5	6.4
	Black Phoebe	3	3.8
	Blue-gray Gnatcatcher	3	3.8
	Common Raven	5	6.4
	Song Sparrow	4	5.1
	Bewick's Wren	4	5.1
	Yellow Warbler	4	5.1
Total #/ Hectare	House Finch	2	2.6
S = 51.1	**Totals**	**40**	**Mean = 5.1**

Table 29. Burnt Springs Avian Monitoring - July 3, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/03/01/ #1	Song Sparrow	5	6.4
	Bell's Vireo	4	5.1
	Blue-gray Gnatcatcher	3	3.8
	Common Yellowthroat	7	8.9
	Bewick's Wren	1	1.3
	Common Raven	4	5.1
	Lucy's Warbler	4	5.1
	Yellow-breasted Chat	5	6.4
Total #/ Hectare	Great-blue Heron	1	1.3
S = 43.4	**Totals**	**34**	**Mean = 4.8**

River Mile 264.0L

Table 30. RM 264.0 Avian Monitoring - June 20, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/20/01/ #1	Yellow-breasted Chat	4	5.1
	Lucy's Warbler	2	2.6
	Bell's Vireo	4	5.1
	Black Phoebe	1	1.3
	Blue-gray Gnatcatcher	2	2.6
	Mourning Dove	1	1.3
	Canyon Wren	1	1.3
Total #/ Hectare	Song Sparrow	1	1.3
S = 20.6	**Totals**	**16**	**Mean = 2.6**

Table 31. River Mile 264.0L Avian Monitoring - July 4, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/04/01/ #1	Bell's Vireo	13	16.6
	Canyon Wren	1	1.3
	Yellow-breasted Chat	8	10.2
	Lucy's Warbler	10	12.7
	Black Phoebe	5	6.4
	Song Sparrow	8	10.2
	Blue-gray Gnatcatcher	9	11.4
	Say's Phoebe	3	3.8
	Mourning Dove	10	12.7
	Hooded Oriole	1	1.3
	Yellow Warbler	2	2.6
	Common Yellowthroat	1	1.3
	Bewick's Wren	1	1.3
	White-throated Swift	1	1.3
	Common Raven	1	1.3
	Summer Tananger	1	1.3
Total #/ Hectare	Brown-headed Cowbird	2	2.6
S = 98.3	**Totals**	**77**	**Mean = 5.8**

Table 32. River Mile 264.0L Avian Monitoring - July 18, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/18/01/ #1	Bell's Vireo	4	5.1
	Lucy's Warbler	4	5.1
	Yellow-breasted Chat	4	5.1
	Say's Phoebe	1	1.3
	Mourning Dove	2	2.6
	Song Sparrow	3	3.8
	Black Phoebe	2	2.6
	Yellow Warbler	1	1.3
	Bewick's Wren	2	2.6
	Cliff Swallow	1	1.3
Total #/ Hectare	Canyon Wren	2	2.6
S = 36.0	**Totals**	**26**	**Mean = 3.3**

Bat Cave

Table 33. Bat Cave Avian Monitoring - June 20, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
06/20/01/ #1	Yellow-breasted Chat	7	8.9
	Lucy's Warbler	6	7.6
	Say's Phoebe	3	3.8
	House Finch	3	3.8
	Yellow Warbler	2	2.6
	Blue-gray Gnatcatcher	2	2.6
	Common Yellowthroat	6	7.6
	Song Sparrow	5	6.4
	Ash-throated Flycatcher	2	2.6
	Blue Grosbeak	2	2.6
	Bell's Vireo	1	1.3
Total #/ Hectare	Blue Jay???	1	1.3
S = 51.1	**Totals**	**40**	**Mean = 4.3**

Table 34. Bat Cave Avian Monitoring - July 4, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/04/01/ #1	Bell's Vireo	9	11.4
	Song Sparrow	7	8.9
	Common Yellowthroat	7	8.9
	Yellow Warbler	8	10.2
	Lucy's Warbler	6	7.6
	Yellow-breasted Chat	5	6.4
	Turkey Vulture	1	1.3
	Ash-throated Flycatcher	4	5.1
	Brown-headed Cowbird	3	3.8
	House Finch	4	5.1
	Blue-gray Gnatcatcher	3	3.8
Total #/ Hectare	Great-blue Heron	2	2.6
S = 75.1	**Totals**	**52**	**Mean = 6.3**

Table 35. Bat Cave Avian Monitoring - July 18, 2001			
DATE/POINT	**SPECIES**	**NUMBER**	**# PER HECTARE**
07/18/01/ #1	Yellow-breasted Chat	6	7.6
	Common Yellowthroat	5	6.4
	Bell's Vireo	5	6.4
	Song Sparrow	6	7.6
	Ash-throated Flycatcher	3	3.8
	Lucy's Warbler	3	3.8
	Black Phoebe	3	3.8
	Brown-headed Cowbird	1	1.3
	Canyon Wren	1	1.3
Total #/ Hectare	Great-blue Heron	3	3.8
S = 45.8	**Totals**	**36**	**Mean = 4.6**

Small Mammal Monitoring

The Spencer and Quartermaster Upland Transects supported a higher number of species and individuals compared to the riparian transects (Table 36). These results are similar to those found in 1995 (Christensen 1995). The riparian transects were located in monotypic tamarisk stands which apparently are not as suitable as the more diverse adjacent upland habitats. In addition, the physical complexity of the upland habitats is greater whereby there are more rocks, crevices etc. for the animals to live in. We are unsure how operation of Glen Canyon Dam affects small mammal populations, but continued monitoring is needed to establish a better baseline data base for future comparisons.

Canyon mice (*Peromyscus crinitus*), rock pocket mice (*Perognathus intermedius*), cactus mice (*Peromyscus eremicus*) and desert woodrats (*Neotoma lepida*) were all commonly captured at each of the study sites (Tables 37-50). These species were also common in 1995 surveys and no new species were detected in 2001. **Funding limitations precluded statistical comparisons of between-year small mammal abundances.**

Table 36. Summary of small mammal abundances and diversities across sites in 2001.

SITE	MEAN # OF SPECIES	MEAN # OF INDIVIDUALS	% TRAP SUCCESS	# OF SURVEYS
Spencer upland	4.0	15.3	0.48	4
Spencer riparian	3.0	10.3	0.31	4
Quartermaster upland	4.0	12.5	0.42	2
Quartermaster riparian	2.5	6.5	0.18	4

Spencer Beach

Table 37. Spencer Beach Small Mammal Monitoring - June 5, 2001			
TRANSECT/ #TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Riparian/ 50 traps	*Peromyscus crinitus*	4	0.08
	Peromyscus eremicus	5	0.10
	Totals	**9**	**Mean = 0.18**

Table 38. Spencer Beach Small Mammal Monitoring - June 5, 2001			
TRANSECT	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Upland/ 42 traps	*Peromyscus crinitus*	6	0.14
	Peromyscus maniculatus	5	0.12
	Peromyscus eremicus	4	0.10
	Neotoma lepida	3	0.07
	Totals	**18**	**Mean = 0.43**

Table 39. Spencer Beach Small Mammal Monitoring - June 19, 2001			
TRANSECT/ #TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Riparian/ 30 traps	*Peromyscus crinitus*	2	0.07
	Peromyscus eremicus	8	0.27
	Neotoma lepida	3	0.10
	Totals	**13**	**Mean = 0.43**

Table 40. Spencer Beach Small Mammal Monitoring - June 19, 2001			
TRANSECT/# TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Upland/ 30 traps	*Peromyscus crinitus*	6	0.20
	Perognathus intermedius	3	0.10
	Peromyscus eremicus	4	0.13
	Neotoma lepida	3	0.10
	Totals	**16**	**0.53**

Table 41. Spencer Beach Small Mammal Monitoring - July 3, 2001			
TRANSECT/ #TRAPS	**SPECIES**	**NUMBER**	**MEAN#/TRAP**
Upland #1/ 26 traps	*Perognathus intermedius*	4	0.15
	Peromyscus crinitus	6	0.23
	Neotoma lepida	2	0.08
	Peromyscus eremicus	2	0.08

	Totals	**14**	**Mean = 0.54**

Table 42. Spencer Beach Small Mammal Monitoring - July 3, 2001			
TRANSECT/ #TRAPS	**SPECIES**	**NUMBER**	**MEAN #/TRAP**
Riparian/30 traps	*Perognathus intermedius*	5	0.17
	Neotoma lepida	1	0.03
	Peromyscus eremicus	2	0.06
	Totals	**8**	**Mean = 0.26**

Table 43. Spencer Beach Small Mammal Monitoring - July 17, 2001			
TRANSECT/# OF TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Upland/ 30 Traps	*Perognathus intermedius*	6	0.20
	Peromyscus crinitus	4	0.13
	Peromyscus eremicus	1	0.03
	Neotoma lepida	2	0.06
	Totals	**13**	**Mean = 0.43**

Table 44. Spencer Beach Small Mammal Monitoring - July 17, 2001			
TRANSECT/# OF TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Riparian/30 traps	*Peromyscus crinitus*	5	0.17
	Neotoma lepida	2	0.07

	Perognathus intermedius	2	0.07
	Peromyscus eremicus.	2	0.07
	Totals	**11**	**Mean = 0.38**

Quartermaster Canyon

Table 45. Quartermaster Canyon Small Mammal Monitoring - June 6, 2001			
TRANSECT/ #TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Front Left/ 29 traps	*Peromyscus crinitus*	1	0.03
	Totals	**1**	**0.03**

Table 46. Quartermaster Canyon Small Mammal Monitoring - June 20, 2001			
TRANSECT/ #TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Front Left/ 44 traps	*Peromyscus crinitus*	4	0.09
	Peromyscus eremicus	8	0.18
	Perognathus intermedius	1	0.02
	Totals	**13**	**0.29**

Table 47. Quartermaster Canyon Small Mammal Monitoring - July 4, 2001			
TRANSECT/ # TRAPS	**SPECIES**	**NUMBER**	**MEAN #/ TRAP**
Front Left/ 30 traps	*Peromyscus crinitus*	2	0.07
	Peromyscus eremicus	1	0.03

	Totals	**3**	**Mean = 0.10**

Table 48. Quartermaster Canyon Small Mammal Monitoring - July 4, 2001			
TRANSECT/ # TRAPS	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Upland/ 30 traps	*Peromyscus eremicus*	2	0.07
	Perognathus intermedius	5	0.17
	Peromyscus crinitus	3	0.10
	Neotoma lepida	2	0.07
	Totals	**12**	**Mean = 0.41**

Table 49. Quartermaster Small Mammal Monitoring - July18, 2001			
TRANSECT/# OF TRAPS	**SPECIES**	**NUMBER**	**MEAN #/TRAP**
Upland/30 traps	*Perognathus intermedius*	7	0.23
	Peromyscus crinitus	3	0.10
	Peromyscus eremicus	2	0.07
	Neotoma lepida	1	0.03
	Totals	**13**	**Mean = 0.43**

Table 50. Quartermaster Small Mammal Monitoring - July 18, 2001

TRANSECT/# OF TRAPS	SPECIES	NUMBER	MEAN #/TRAP
Front Left/30 traps	*Perognathus intermedius*	4	0.13
	Peromyscus crinitus	3	0.10
	Peromyscus eremicus	1	0.03
	Neotoma lepida	1	0.03
	Totals	**9**	**Mean = 0.29**

Reptile Monitoring

Reptile diversities and abundances were also greater at the Spencer and Quartermaster Canyon upland transects relative to the riparian transects (Table 51). These patterns are similar to that of the small mammal populations and possibly for the same reasons. Again, we are unsure at this time how operation of Glen Canyon Dam affects reptile abundances and diversities, but continued monitoring is needed to better establish a data base for future comparisons.

Whiptail lizards (*Cnemidophorus tigris*), tree lizards (*Urosaurus ornatus*), side-blotch lizards (*Uta stansburiana*) were common at all the study sites (Tables 52-62). Two species not previously encountered in our 1995 surveys were the collared lizard (*Crotophyta collaris*) which occurred at both the Spencer Beach and Quartermaster Canyon Upland Transects and the northern leopard lizard (*Gambelia wislizenii*) which occurred at the Spencer Beach Upland Transect. Another species, the desert spiny lizard (*Sceloperus magister*) was previously documented at both sites, but was not seen in the 2001 surveys. **Funding limitations precluded statistical comparisons of between-year reptile abundances.**

Table 51. Summary of reptile abundances and diversities across sites in 2001

SITE	MEAN # OF SPECIES	MEAN # OF INDIVIDUALS	MEAN #/ MINUTE	# OF SURVEYS
Spencer Beach - upland	3.8	9.5	0.32	4
Spencer Beach - riparian	1.7	8.7	0.29	3
Quartermaster - upland	3.5	7.5	0.27	2

Quartermaster - riparian	1.0	1.0	0.03	2

Spencer Beach

Table 52. Spencer Beach Reptile Monitoring - June 5, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Riparian/ 30 min.	*Cnemidophorus tigris*	13	0.43
	Urosaurus ornatus	1	0.03
	Totals	**14**	**Mean = 0.47**

Table 53. Spencer Beach Reptile Monitoring - June 5, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Upland/ 30 min.	*Uta stansburiana*	6	0.20
	Urosaurus ornatus	4	0.13
	Cnemidophorus tigris	4	0.13
	Gambelia wislizenii	2	0.07
	Crotophytus collaris	1	0.03
	Totals	**17**	**Mean = 0.57**

Table 54. Spencer Beach Reptile Monitoring - June 19, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Riparian/ 30 min.	*Cnemidophorus tigris*	5	0.17
	Totals	**5**	**Mean = 0.17**

Table 55. Spencer Beach Reptile Monitoring - June 19, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**

Upland/ 30 min.	*Uta stansburiana*	5	0.17
	Urosaurus ornatus	2	0.07
	Cnemidophorus tigris	2	0.07
	Crotophyta collaris	1	0.03
	Totals	**10**	**Mean = 0.34**

Table 56. Spencer Beach Reptile Monitoring - July 3, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Riparian/ 30 min.	*Cnemidophorus tigris*	5	0.17
	Urosaurus ornatus	2	0.07
	Totals	**7**	**Mean = 0.24**

Table 57. Spencer Beach Reptile Monitoring - July 3, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Upland/ 30 min.	*Cnemidophorus tigris*	2	0.07
	Urosaurus ornatus	3	0.10
	Crotophyta collaris	2	0.07
	Uta stansburiana	1	0.04
	Totals	**8**	**Mean = 0.28**

Table 58. Spencer Beach Reptile Monitoring - July 17, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Upland/30 Min.	*Uta stansburiana*	2	0.07
	Urosaurus ornatus	1	0.03
	Totals	**3**	**Mean = 0.10**

Quartermaster Canyon

Table 59. Quartermaster Canyon Reptile Monitoring - July 4, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Upland/ 30 min.	*Cnemidophorus tigris*	3	0.10
	Urosaurus ornatus	4	0.13
	Crotophyta collaris	1	0.03
	Uta stansburiana	1	0.03
	Totals	**9**	**Mean = 0.29**

Table 60. Quartermaster Canyon Reptile Monitoring - July 4, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Front Left/ 30 min.			
	Totals	**0**	**Mean = 0.0**

Table 61. Quartermaster Reptile Monitoring - July 18, 2001			
TRANSECT/TIME	**SPECIES**	**NUMBER**	**NUMBER/MIN.**
Upland/25 min.	*Uta stansburiana*	3	0.12
	Urosaurus ornatus	2	0.08
	Crotophyta collaris	1	0.04
	Totals	**6**	**Mean = 0.24**

Table 62. Quartermaster Reptile Monitoring - July 18, 2001			
TRANSECT/MIN.	**SPECIES**	**NUMBER**	**NUMBER/MIN.**

Riparian/30 min.	*Urosaurus ornatus*	1	0.03
	Cnemidophorus tigris	1	0.03
	Totals	**2**	**Mean = 0.06**

Ethnobotany

Completion of the ethnobotanical surveys will occur in late August, 2001, and the results will be presented in the future.

Literature Cited

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